VHF Filter Unit

MA 4072

Technical Manual

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RACAL
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V.H.F. Filter Unit MA. 4072

HANDBOOK AMENDMENTS

Amendments to this handbook (if any), which are on coloured paper for ease of identification, will be found at the rear of the book. The action called for by the amendments should be carried out by hand as soon as possible.

'POZIDRIV' SCREWDRIVERS

Metric thread cross-head screws fitted to Racal equipment are of the 'Pozidriv' type. Phillips type and 'Pozidriv' type screwdrivers are not interchangeable, and the use of the wrong screwdriver will cause damage. POZIDRIV is a registered trade mark of G.K.N. Screws and Fasteners Limited The 'Pozidriv' screwdrivers are manufactured by Stanley Tools Limited.

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TECHNICAL SPECIFICATION

Electrical Characteristics

Frequency Range: From 36 MHz to 76 MHz in six bands: manually selected by rotary switch.

(i)	36-39 MHz	(iv)	52-60 MHz
(ii)	39-44 MHz	(v)	60-68 MHz
(iii)	44-52 MHz	(vi)	68-76 MHz

RF input and output impedances: Nominally 50 ohms.

RF power level: 8 watts maximum.

Insertion loss: 3.5 dB maximum.

Selectivity: Better than 45 dB at closest edge of adjacent band but one. Better than 70 dB at 20% below band edge (down to 2 MHz). Better than 70 dB at frequencies 35% above band edge (up to 150 MHz).

DC path: DC path present between input and output to enable switching information to pass from TRA.967 to the MA.972 Antenna Matching Unit.

Environmental:

Operating temperatures:	$-10^{\circ}C$ to $+70^{\circ}C$
Storage temperatures:	$-40^{\circ}C$ to $+90^{\circ}C$

The unit is fully sealed. A desiccator is provided to indicate humidity above a certain level.

Mechanical Characteristics

Dimensions:

Length	Width	Height
244 mm	195 mm	60 mm

Weight: 2.6 Kg

Controls and Connectors: Six-position rotary switch.

RF INPUT and OUTPUT sockets (BNC).

GENERAL DESCRIPTION

INTRODUCTION

1. The purpose of the MA.4072 is to permit two TRA.967 Transmitter/Receiver sets to operate in close proximity, such as on radio rebroadcast, without mutual interference. One MA.4072 unit is required in each Transmitter/Receiver Assembly, and is connected in the r.f. feeder path as shown in the Typical Installation diagram (Fig. 1.1 on the following page). The output socket of the MA.4072 may be connected direct to the Antenna Matching Unit, or via the V.H.F. Amplifier Unit as shown in Fig. 1.1.

2. The function of the filter unit is to eliminate 'blocking' in the receiver due to break-through from the adjacent transmitting set, while in the transmitting set the filter reduces wideband noise from the synthesizer. The unit also allows a d.c. voltage to be passed to the Antenna Matching Unit for bandswitching purposes.

ANTENNA SEPARATION

3. The minimum separation between antennas is two metres. This separation should be increased, where possible, in order to reduce the probability of mutual interference on certain frequencies.

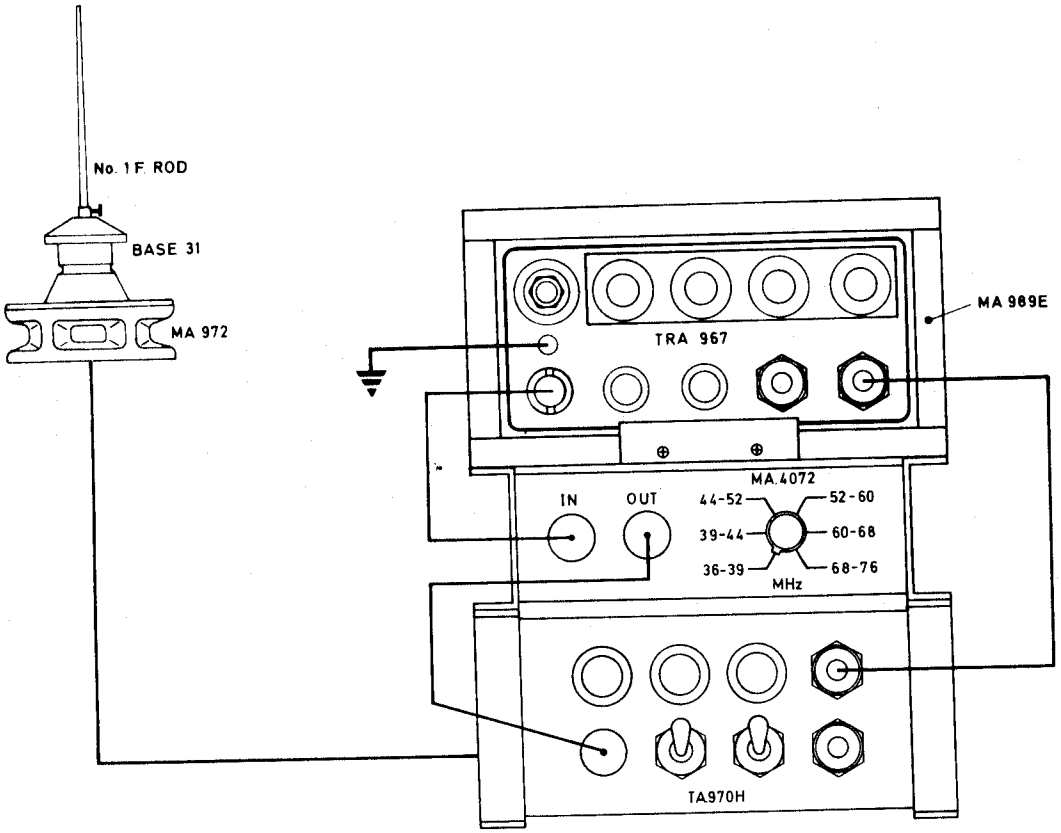
CHANNEL SELECTION

4. For simultaneous operation of the two transmitter/receivers the switch settings on the MA.4072 units must differ by at least two steps. For example if Set A is transmitting via Band 1 then Set B may receive via Bands 3, 4, 5 or 6. If transmitting via Band 3, then the receiver in the other set may use Bands 1, 5 or 6, and so on. Refer to the mutual interference graph and notes on Pages 6 and 7 for operational guidance.

CONSTRUCTION

5. The MA.4072 is contained in a cast alloy box with drilled flanges which permit the unit to be bolted to the Mounting Frame MA.989E and to the Amplifier TA.970H. The circuit components are mounted on a printed circuit board which is accessible by removal of the top and bottom plates. Each plate is secured by six screws.

6. Two BNC sockets (IN and OUT) together with the six-way rotary band selector switch are mounted on the front panel. The switch shaft is extended through the rear panel, the shaft extension being covered by a protective dome if rear panel control is not required. A screwed-in desiccator is fitted to the rear panel.



WOH6080 A

VHF Station with Six-Band Filter Unit MA.4072 Fig 1.1

INSTALLATION AND OPERATION

IMPORTANT NOTE

Maintain the maximum possible separation between the antennas of the two sets. The minimum acceptable separation is two metres. Increased separation will reduce the probability of mutual interference on certain frequencies.

INSTALLATION

7. Refer to Fig. 1.1 on the opposite page and connect up the units as follows:-

MA.4072 SOCKET	CONNECTED TO
IN Socket	TRA.967 '50Ω' socket.
OUT Socket	Low Power Antenna Matching Unit MA.972. High Power To Input socket of Amplifier TA.970H (rear panel) if this unit is fitted in the installation.

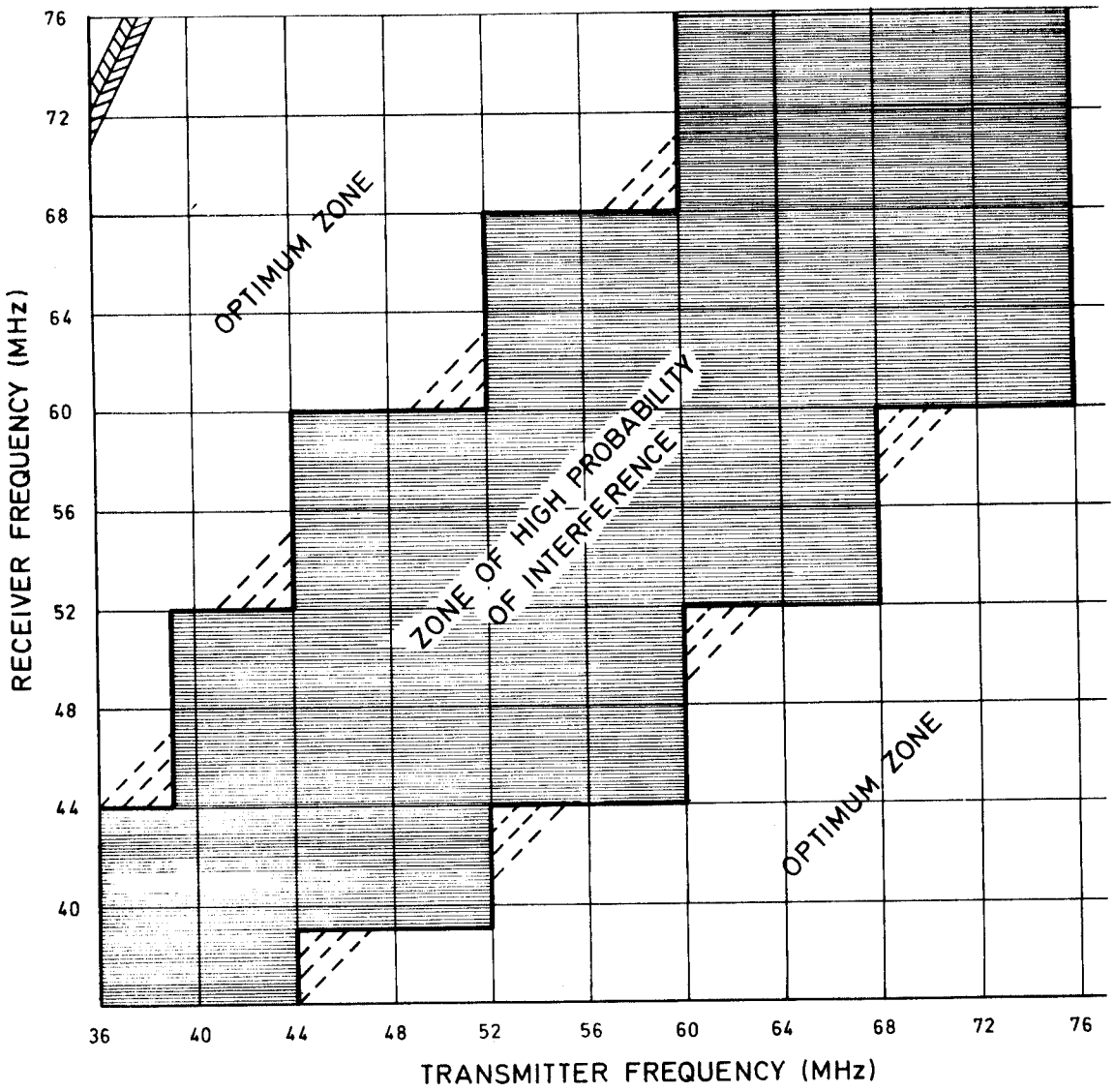
OPERATING

Transmitting

8. Set the Band switch to the frequency band which contains the required transmission frequency.

Receiving

9. Set the Band switch to a band which differs by two steps from the transmitting frequency of the other installation. Refer to the Note in paragraph 3 and also the mutual interference graph on the following page.



WOH6080

Mutual Interference Graph Fig.1.2

(SEE NOTES ON PAGE 7)

MUTUAL INTERFERENCE GRAPH

NOTES

Figure 1.2 is a graph showing the liability to mutual interference for any combination of transmitter and receiver frequencies. The graph assumes that high power (25 watt) sets are in use with antenna separation of 2 metres. Receiver frequencies are shown vertically on the left and transmitter frequencies horizontally across the bottom of the diagram. The intersection of any selected pair of operating frequencies should be evaluated as follows:-

(i) The diagonal shaded zone across the centre of the graph represents the area most liable to mutual interference. Operating frequencies which intersect in this area should be avoided unless antenna separation can be increased.

(ii) The diagonal dashed lines across the right angled steps of the graph indicate small areas where a lesser risk of interference exists. These small interference areas do not exist when low powered (5 watt) equipment is used.

(iii) The unshaded "optimum" zones indicate freedom from mutual interference. Operating frequencies should be chosen which intersect in these zones as far as possible.

(iv) A small shaded strip at the top left hand corner indicates a possibility of second harmonic interaction if the lowest transmitter frequencies are used in combination with the highest receiving frequencies.

(v) It should be noted that the liability to mutual interference is reduced if antenna separation is increased.

CIRCUIT DESCRIPTION

R.F. FILTERS

10. Referring to the circuit diagram (Fig. 2) each r.f. filter path consists of a chain of capacitively critically-coupled sections employing fixed capacitors and pre-set inductors. For reference purposes, the filter paths are numbered 1 to 6 on the circuit and layout diagrams.

11. The r.f. signal (and the d.c. input) are fed in via socket SK1 to switch SA, which directs the r.f. signal to the selected filter path. The filtered signal is then fed via switch SB to the output socket SK2. Switch wafers SA and SB are mounted on the same shaft, but at opposite ends of the unit.

D.C. PATH

12. A direct current supply for band-switching in the Antenna Matching Unit is fed in on the coaxial input of SK1. This d.c. signal is blocked by the capacitive coupling of the r.f. filters but is accepted by the low-pass filter L39-L41, C83/C84 and fed to the output socket SK2. The low-pass filter eliminates all h.f. and v.h.f. signals from the d.c. path.

MAINTENANCE

REMOVAL FROM INSTALLATION FRAME

13. Remove the four bolts holding the unit to the frame MA.989E, and also the four bolts holding it to the Amplifier unit TA.970H (if fitted), and withdraw the unit.

DESICCATOR CHECK

14. The desiccator should be checked at the same time as the check on the associated transmitter-receiver set. The desirable crystal colour is blue. The desiccator is located at the rear of the unit and may be unscrewed and withdrawn through the panel.

15. If the crystals are not blue the desiccator may be reactivated by placing in an oven, or similar source of 'clean' dry heat, at a temperature 120° - 150°C for approximately two hours. Allow the desiccator to cool before re-fitting.

PERFORMANCE CHECK AND FILTER CALIBRATION

INTRODUCTION

16. The performance check, below, will verify the serviceability of the MA.4072 by checking insertion loss, using a minimum of test equipment. For a detailed alignment check reference should be made to paragraphs 19 to 22.

TEST EQUIPMENT FOR PERFORMANCE CHECK

17. (a) V.H.F. Test Set, Racal CA.4001, with connector lead assembly for the associated transmitter-receiver. Alternatively an R.F. Power meter, with 50Ω input, capable of measuring 5 watts at 80 MHz may be used.

(b) V.H.F. Transmitter-Receiver Racal TRA.967.

PERFORMANCE CHECK PROCEDURE

18. NOTE: The following procedure refers to the CA.4001 but may be adapted to a suitable r.f. power meter.

(1) Disconnect the existing power supply from the Transmitter-Receiver TRA.967.

(2) Using the appropriate connector lead assembly, connect socket SK2 on the CA.4001 to the AUDIO 1 socket on the TRA.967.

(3) Connect a coaxial lead between the '50Ω' socket on the TRA.967 and the "RF" socket on the CA.4001.

(4) On the CA.4001 set the SUPPLY and MODULATION switches to OFF, the Meter switch to '5W' and the T-R switch to 'T'.

(5) On the TRA.967 set the Mode switch to NOISE and the Frequency switches to 36.000 MHz.

(6) Connect the a.c. supply to the CA.4001 and set the SUPPLY switch to ON.

(7) Press the TRA.967 PTT switch and note the r.f. power reading on the test set as a reference (P1).

(8) Disconnect the transmitter coaxial lead from the CA.4001 and transfer it to the IN socket of the MA.4072.

(9) Connect a second length of coaxial lead between the OUT socket of the MA.4072 and the R.F. socket of the CA.4001.

(10) Set the Band switch of the MA.4072 to the '36-39 MHz' position.

(11) Press the PTT switch and note the power reading (P2) on the test set. Verify that this reading is not less than 45 percent of the reading (P1) recorded in (7).

(12) Release the PTT switch. Disconnect the MA.4072 from the CA.4001 'RF' socket and re-connect the TRA.967 coaxial output lead to the CA.4001 in lieu.

(13) Repeat operations (7) to (12) at the following frequency selections on the TRA.967 and the MA.4072:-

TRA.967 Frequency	MA.4072 Band Switch
MHz	MHz
39.000	(36-39 (39-44
44.000	(39-44 (44-52
52.000	(44-52 (52-60
60.000	(52-60 (60-68
68.000	(60-68 (68-76
76.000	68-76

(14) Switch off and disconnect the test equipment. If any filter path is below the limit specified in operation (11) the filter alignment check should be carried out.

FILTER CALIBRATION

NOTE: If the specified class of test equipment is not available, the MA.4072 should be returned to Racal Tacticom Ltd, or authorized agent, for repair and calibration.

Test Equipment Required

19. (a) V.H.F. Sweep Frequency Generator with Display.

Frequency Range:	35-80 MHz
Impedance:	50 ohms
Markers:	At 1 MHz intervals
Examples:-	Knott Polyskanner Rhode and Schwarz Polyskop

(b) Multimeter: For continuity tests

Example:- Avo 8

Check on D.C. Path

20. (1) Using the multimeter on 'Ohms' check for continuity between the IN and OUT BNC socket pins. With the meter on the ÷ 100 range the resistance should be approximately 5 ohms.

(2) Check that no continuity exists between the socket pins and chassis.

Filter Path Alignment Check

21. (1) Remove the top cover from the MA.4072 by extracting the six retaining screws.

(2) First set up the Sweep Generator and Display as follows:-

(i) Connect the RF output of the Sweep Generator to the RF input of the Display using two coaxial cables of approximately the same length and a straight BNC adaptor.

(ii) Set the output attenuator to 6 dB. Adjust the vertical gain of Display unit to place the reference line approximately in the centre of the screen. Note the position of this line as a reference.

(iii) Set the swept range to 36-39 MHz with the aid of internal markers. Adjust the horizontal gain of the Sweep Generator so that this range covers approximately the whole of the screen, to prevent possible overloading of the display unit.

(iv) Remove the BNC adaptor from the coaxial cables and connect up the MA.4072 as follows:-

MA.4072		Sweep Generator/Display
IN Socket	←	RF Output
OUT Socket	→	RF Input

(3) On the MA.4072 select Band 1 (36-39 MHz).

(4) Locate the corresponding filter path on the p.c.b. by noting the identification number on the board. (See also the Layout diagram, Figure 1 at the back of the handbook).

(5) Observe the pass band on the display. Check for correct bandwidth, roll off and freedom from ripple. If correction is required continue as follows:-

(6) Using a trimming tool unscrew all the inductor cores until they are flush with the tops of the coils.

(7) With cores unscrewed, the pass band may not be visible. Carefully make small increases in coil inductance while observing the display. (During this process it will be helpful to reduce Sweep Generator attenuation by a few dB's until the passband is visible).

(8) Adjust the cores until the pass band is seen clearly on the display. If the Sweep Generator attenuation was reduced in (7) it should now be restored to the original 6 dB setting.

(9) If there are large ripples in the passband, fine adjustment of the middle group of inductors may be necessary. If the band edges are rolling off too slowly, adjust the two end inductors.

(10) Reduce the Sweep Generator attenuation by 3 dB from its original 6 dB setting and verify that the passband (between the band edge markers) is above the reference line.

(11) Repeat the entire procedure from operation (2) for each of the remaining frequency bands, 2, 3, 4, 5 and 6, setting the sweep generator to the frequency range of the filter passband in each case.

(12) Finally, disconnect the test equipment and refit the cover.

PARTS LIST

ORDERS FOR SPARE PARTS

To expedite handling of spare parts orders please quote:-

1. Type and serial number of equipment.

2. Circuit reference, description and Racal part number of each item.

3. Quantity required.

The serial number plate for the equipment is positioned on the rear panel.

Cct. Ref.	Value	Description	Rat.	Tol %	Racal Part Number

LIST OF COMPONENTS

MAIN CHASSIS ITEMS

SA	Switch, rotary, 1 pole 6 way				711461
SB	Switch, rotary, 1 pole 6 way				711434
SK1	Socket, BNC, bulkhead				919582
SK2	Socket, BNC, bulkhead				919582
	Desiccator, $\frac{3}{4}$ inch				909909

FILTER P.C.B. ASSEMBLY 713158

Capacitors

	F		V		
C1	100p	Silver Mica	350	2	902161/EQ
C2	180p	Silver Mica	350	2	902167
C3	12p	Ceramic	63	2	921131/EQ
C4	120p	Silver Mica	350	2	902163
C5	12p	Ceramic	63	2	921131/EQ
C6	120p	Silver Mica	350	2	902163
C7	12p	Ceramic	63	2	921131/EQ
C8	120p	Silver Mica	350	2	902163
C9	12p	Ceramic	63	2	921131/EQ
C10	120p	Silver Mica	350	2	902163
C11	12p	Ceramic	63	2	921131/EQ
C12	100p	Silver Mica	350	2	902161/EQ
C13	180p	Silver Mica	350	2	902167
C14	82p	Silver Mica	350	2	902159/EQ
C15	120p	Silver Mica	350	2	902163
C16	12p	Ceramic	63	2	921131/EQ
C17	100p	Silver Mica	350	2	902161/EQ
C18	12p	Ceramic	63	2	921131/EQ
C19	100p	Silver Mica	350	2	902161/EQ
C20	12p	Ceramic	63	2	921131/EQ

C41	68p	Silver Mica	350	2	902155
C42	39p	Silver Mica	63	±0.25p	921129
C43	56p	Ceramic	350	±1p	902153/EQ
C44	8.2p	Silver Mica	63	±0.25p	921129
C45	47p	Ceramic	350	±1p	902153/EQ
C46	8.2p	Silver Mica	63	±0.25p	921129
C47	47p	Ceramic	350	±1p	902153/EQ
C48	8.2p	Silver Mica	63	±0.25p	921129
C49	47p	Ceramic	350	±1p	902153/EQ
C50	8.2p	Silver Mica	63	±0.25p	921129
C51	47p	Ceramic	350	±1p	902153/EQ
C52	8.2p	Silver Mica	63	±0.25p	921129
C53	47p		350	±1p	902153/EQ

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number
		Filter P.C.B. Assembly (continued)			
C54	8.2p	Ceramic	63	±0.25p	921129
C55	39p	Silver Mica	350	±1p	902151/EQ
C56	56p	Silver Mica	350	2	902155
C57	27p	Silver Mica	350	±1p	902147 /EQ
C58	47p	Silver Mica	350	±1p	902153 /EQ
C59	5.6p	Ceramic	63	±0.25p	925414
C60	39p	Silver Mica	350	±1p	902151 /EQ
C61	5.6p	Ceramic	63	±0.25p	925414
C62	39p	Silver Mica	350	±1p	902151 /EQ
C63	5.6p	Ceramic	63	±0.25p	925414
C64	39p	Silver Mica	350	±1p	902151/EQ
C65	5.6p	Ceramic	63	±0.25p	925414
C66	39p	Silver Mica	350	±1p	902151 /EQ
C67	5.6p	Ceramic	63	±0.25p	925414
C68	27p	Silver Mica	350	±1p	902147 /EQ
C69	47p	Silver Mica	350	±1p	902153/EQ
C70	18p	Silver Mica	350	±1p	902143/EQ
C71	33p	Silver Mica	350	±1p	902149
C72	3.9p	Ceramic	63	±0.25p	925603
C73	27p	Silver Mica	350	±1p	902147/EQ
C74	3.9p	Ceramic	63	±0.25p	925603
C75	27p	Silver Mica	350	±1p	902147/EQ
C76	3.9p	Ceramic	63	±0.25p	925603
C77	27p	Silver Mica	350	±1p	902147 /EQ
C78	3.9p	Ceramic	63	±0.25p	925603
C79	27p	Silver Mica	350	±1p	902147/EQ
C80	3.9p	Ceramic	63	±0.25p	925603
C81	18p	Silver Mica	350	±1p	902143/EQ
C82	33p	Silver Mica	350	±1p	902149
C83	.01µ	Ceramic	40	+100 -20	924737/EQ
C84	.01µ	Ceramic	40	+100 -20	924737/EQ

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number
		Filter P.C.B. Assembly (continued)			
Inductors					
L1		Coil Assembly			710277
L2		Coil Assembly			710278
L3		Coil Assembly			710278
L4		Coil Assembly			710278
L5		Coil Assembly			710278
L6		Coil Assembly			710277
L7		Coil Assembly			710277
L8		Coil Assembly			710278
L9		Coil Assembly			710278
L10		Coil Assembly			710278
L11		Coil Assembly			710278
L12		Coil Assembly			710277
L13		Coil Assembly			710277
L14		Coil Assembly			710278
L15		Coil Assembly			710278
L16		Coil Assembly			710278
L17		Coil Assembly			710278
L18		Coil Assembly			710278
L19		Coil Assembly			710277
L20		Coil Assembly			710277
L21		Coil Assembly			710278
L22		Coil Assembly			710278
L23		Coil Assembly			710278
L24		Coil Assembly			710278
L25		Coil Assembly			710278
L26		Coil Assembly			710277
L27		Coil Assembly			710277
L28		Coil Assembly			710278
L29		Coil Assembly			710278
L30		Coil Assembly			710278

LIST OF COMPONENTS

MAIN CHASSIS ITEMS

Cct. Ref.	Value	Description	Rat.	Tol %	Racal Part Number
SA		Switch, rotary, 1 pole 6 way			711461
SB		Switch, rotary, 1 pole 6 way			711434
SK1		Socket, BNC, bulkhead			919582
SK2		Socket, BNC, bulkhead			919582
		Desiccator, $\frac{3}{4}$ inch			909909

FILTER P.C.B. ASSEMBLY 713158

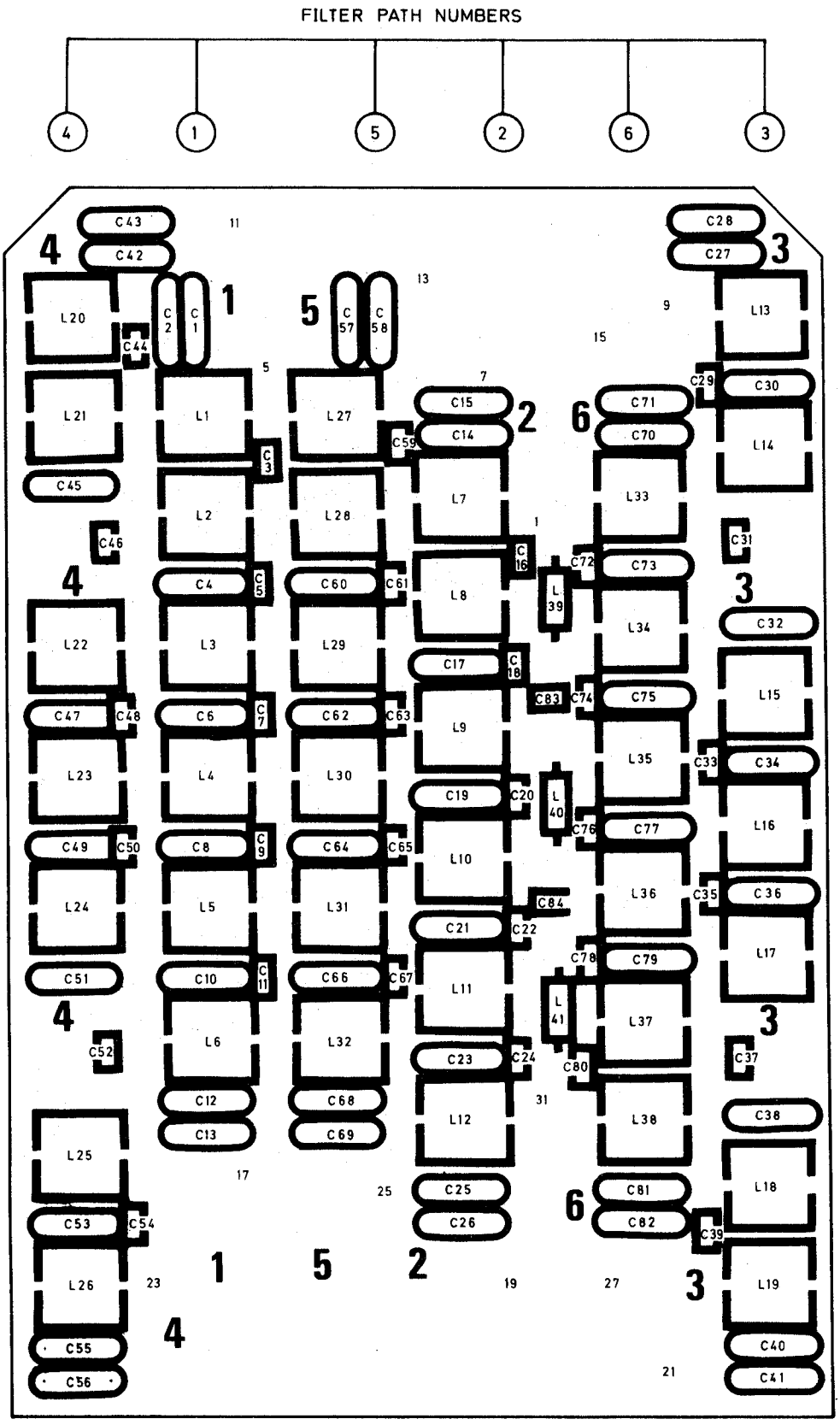
Capacitors

	F		V		
C1	100p	Silver Mica	350	2	902161/EQ
C2	180p	Silver Mica	350	2	902167
C3	12p	Ceramic	63	2	921131/EQ
C4	120p	Silver Mica	350	2	902163
C5	12p	Ceramic	63	2	921131/EQ
C6	120p	Silver Mica	350	2	902163
C7	12p	Ceramic	63	2	921131/EQ
C8	120p	Silver Mica	350	2	902163
C9	12p	Ceramic	63	2	921131/EQ
C10	120p	Silver Mica	350	2	902163
C11	12p	Ceramic	63	2	921131/EQ
C12	100p	Silver Mica	350	2	902161/EQ
C13	180p	Silver Mica	350	2	902167
C14	82p	Silver Mica	350	2	902159/EQ
C15	120p	Silver Mica	350	2	902163
C16	12p	Ceramic	63	2	921131/EQ
C17	100p	Silver Mica	350	2	902161/EQ
C18	12p	Ceramic	63	2	921131/EQ
C19	100p	Silver Mica	350	2	902161/EQ
C20	12p	Ceramic	63	2	921131/EQ

FILTER P.C.B. ASSEMBLY (Continued)

Cct. Ref.	Value	Description	V	Rat	%	Number
	F					
C21	100p	Silver Mica	350	2		902161/EQ
C22	12p	Ceramic	63	2		921131/EQ
C23	100p	Silver Mica	350	2		902161/EQ
C24	12p	Ceramic	63	2		921131/EQ
C25	82p	Silver Mica	350	2		902159/EQ
C26	120p	Silver Mica	350	2		902163
C27	47p	Silver Mica	350	1		902153/EQ
C28	68p	Silver Mica	350	2		902157/EQ
C29	12p	Ceramic	63	2		921131/EQ
C30	68p	Silver Mica	350	2		902157/EQ
C31	12p	Ceramic	63	2		921131/EQ
C32	68p	Silver Mica	350	2		902157/EQ
C33	12p	Ceramic	63	2		921131/EQ
C34	68p	Silver Mica	350	2		902157/EQ
C35	12p	Ceramic	63	2		921131/EQ
C36	68p	Silver Mica	350	2		902157/EQ
C37	12p	Ceramic	63	2		921131/EQ
C38	68p	Silver Mica	350	2		902157/EQ
C39	12p	Ceramic	63	2		921131/EQ
C40	47p	Silver Mica	350	1		902153/EQ
C41	68p	Silver Mica	350	2		902157/EQ
C42	39p	Silver Mica	350	±1p		902151/EQ
C43	56p	Silver Mica	350	2		902155
C44	8.2p	Ceramic	63	±0.25p		921129
C45	47p	Silver Mica	350	±1p		902153/EQ
C46	8.2p	Ceramic	63	±0.25p		921129
C47	47p	Silver Mica	350	±1p		902153/EQ
C48	8.2p	Ceramic	63	±0.25p		921129
C49	47p	Silver Mica	350	±1p		902153/EQ
C50	8.2p	Ceramic	63	±0.25p		921129
C51	47p	Silver Mica	350	±1p		902153/EQ
C52	8.2p	Ceramic	63	±0.25p		921129
C53	47p	Silver Mica	350	±1p		902153/EQ

Cct. Ref.	Value	Description	Rat	Tol %	Racal Part Number
		Filter P.C.B. Assembly (continued)			
L31		Coil Assembly			710278
L32		Coil Assembly			710277
L33		Coil Assembly			710277
L34		Coil Assembly			710278
L35		Coil Assembly			710278
L36		Coil Assembly			710278
L37		Coil Assembly			710278
L38		Coil Assembly			710277
L39	33µH	Choke		5	926327/EQ
L40	15µH	Choke		10	92633I/EQ
L41	33µH	Choke		5	926327/EQ



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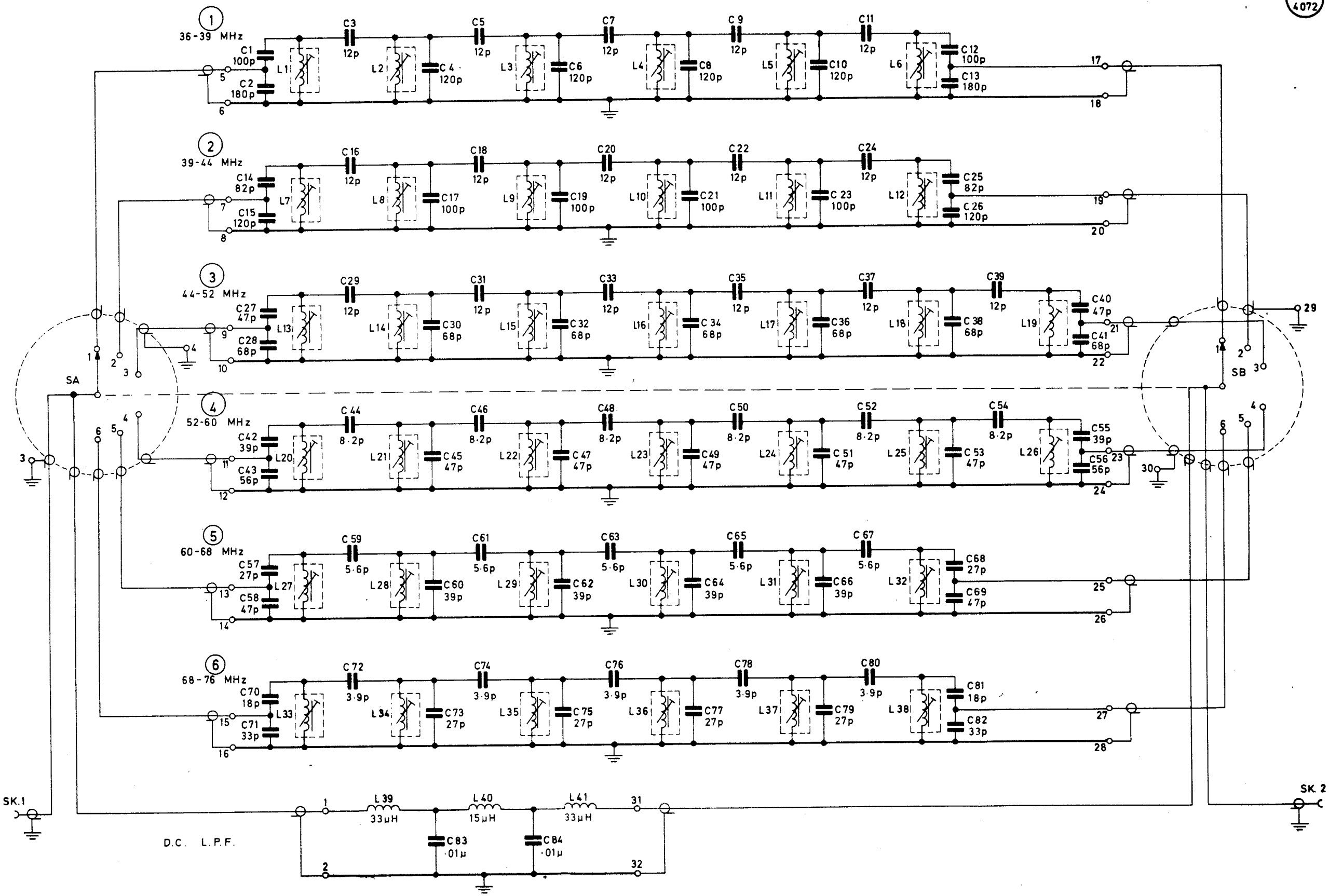
Layout : MA.4072 Circuit Board **Fig.1**

MA 4072



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Circuit : MA.4072 Fig. 2